Composition for improving wrinkle resistance in fabrics, wrinkle-reducing active ingredient as used in such a composition, and cartridge containing such composition

The invention relates to a composition for improving wrinkle resistance in fabrics, comprising: a wrinkle-reducing active ingredient, comprising at least one fusible elastomer, and a liquid carrier for carrying the active ingredient. The invention also relates to a wrinkle-reducing active ingredient as used in such a composition. The invention further relates to a method of improving wrinkle resistance in a fabric by the use of such a composition.

In-Wear Wrinkle Resistance (IWWR), as the name suggests, means the property of a given fabric, e.g. cotton, which enables it to resist the formation of wrinkles, especially during wearing of the fabric. IWWR can be assessed by measuring the ability of a given fabric to resist the formation of wrinkles. Wrinkle resistance is generally assessed by Wrinkle Recovery Angle (WRA) tests. A well-known standard test is the AATCC method 66-1998. Such tests assess the ability of fabric which is set in a flat state to recover this flat state after being folded and subjected to a temporary load, preferably 500 g during 60 s, and then released. The assessment is carried out by measuring the recovered angle (WRA) after a given time (commonly 5 minutes). The greater the angle, the better the recovery. Angles are measured in, both, the warp and weft directions and added up to give a final result of the assessment. A perfectly elastic material would give a WRA of 360 degrees. A perfectly viscous material would give a WRA of 0 degrees.

Compositions for reducing wrinkle formation in fabrics are already known. The American patent publication US 5,532,023 discloses, for example, a wrinkle-reducing composition which can be applied to fabrics. The composition comprises a wrinkle-reducing active ingredient, comprising an effective amount of silicone, and an effective amount of film-forming polymer, which active ingredient is dispersed in a liquid carrier. In particular, the disclosed composition is adapted to impart a lubricating property or increased gliding ability to fibers in fabric, particularly clothing. This gliding effect between the fibers is caused in particular by the silicone. A deformation of the clothing reduces the resistance between the fibers of the clothing, which results commonly in a decreased energy dissipation

at the fibers and (thus) also a relatively good and easy contra-deformation (recovery) of the fibers towards the original state. However, decreasing the resistance between the fibers of the clothing will also facilitate the formation of a wrinkled state of the clothing. Application of the disclosed composition to clothing leads commonly to a WRA of up to about 200 degrees.

It is an object of the invention to provide a novel composition which improves wrinkle resistance in fabrics, without facilitating the formation of a wrinkled state of the fabrics.

This object of the invention is achieved by a composition as mentioned in the opening paragraph, characterized in that the wrinkle-reducing active ingredient further comprises a filler which is at least partly provided with chemically crosslinked particles. The use of a filler with crosslinked particles in combination with a fusible elastomer will commonly lead to a significantly higher recovery of the fabric than the recovery according to the prior art. Application of the composition according to the invention will generally lead to a WRA of significantly above 200 degrees. In particular, the active ingredient according to the invention will form elastic bridges between the fibers of the fabric under normal conditions, so that deformation of the fabric will commonly result in a lasting recovery of the fibers in their original orientation. Thus, the crosslinked particles provide – in combination with the fusible polymer – an elastic bond between the fibers with a certain memory, which enables it to recover relatively easily after bending or creasing of the fibers. Preferably, the crosslinked particles are captured in a matrix of the fusible elastomer. Crosslinked particles that may be used are, for example, polybutadiene, natural rubber, crosslinked silicones such as crosslinked polydimethylsiloxane, and polymeric microfibers. Fusible elastomers used may be, for example, aliphatic polyester polyurethane, aliphatic polyether polyurethane or a acrylate copolymer of butyl acrylate and acrylic acid with a relatively low glass transition temperature (Tg), preferably in a ratio of 80: 20. The liquid carrier used in the composition of the present invention is preferably an aqueous system. Optionally, in addition to water, the carrier may comprise another liquid solvent which is well soluble in water, such as an alcohol.

In a preferred embodiment of the invention, the filler consists entirely, or at least substantially, of chemically crosslinked particles. The elastic property of the crosslinked particles can thus be optimally utilized. For example, a polydimethylsiloxane like

Dow Corning C 1716® may be used, which directly binds itself to the matrix formed by the fusible elastomer.

In another preferred embodiment, the filler is provided with a thermoplast, preferably polymethylmethacrylate (PMMA). In this manner the filler consists in particular of particles comprising at least two compositions, i.e. the crosslinked composition which provides an elastic property to the filler, and a non-crosslinked composition formed by a thermoplast for improving the binding of the filler to the matrix formed by the fusible elastomer. The filler according to this embodiment can be constructed in a laminar way, such that each layer consists of specific compositions. Thus it is also possible to provide, for example, a so called 'core-shell' filler particle, which consists at least substantially of an elastic core formed by said crosslinked composition, which core is surrounded by a substantially non-elastic shell formed by said thermoplastic composition. As crosslinked composition for the core, for example Estapor® carboxylated micro-spheres of SBS copolymer of Merck, may be used.

Preferably, particles of the filler have an at least substantially spherical shape. In a preferred embodiment, however, particles of the filler have an at least substantially fibrous shape, such as micro-fibers. Other shapes may also be used to give the desired anti-wrinkle effect.

The content of the active ingredient in the liquid carrier is between 2 and 60% by weight. Between these values a good dispersion of the active in the liquid carrier can be obtained and maintained. If said percentage of 60 percent is (significantly) exceeded, commonly a sticky, non-controllable dispersion is obtained. Preferably, the filler content in the active is between 10 and 30% by weight, preferably 20% by weight. In this way a stable matrix of fusible elastomer can be obtained, in which the crosslinked fillers are captured.

In an embodiment of the composition according to the present invention, the elastomer has a softening temperature between 50 and 100°C in the presence of water. Easy softening of the elastomer at an increased temperature results commonly in an easy provision of the yarns of the fabric with the composition according to the invention. The viscosity of the softened composition is relatively very low, which means that, for example, during ironing of said fabric, the polymers do not interfere with the wrinkle removal of the fabric as long as the fabric is relatively hot. When the fabric cools down, the composition according to the invention solidifies to form an elastic film around and between the yarns or individual fibers, thereby inducing a degree of elasticity in the treated fabric. This in turns improves the WRA value substantially.

In another preferred embodiment of the composition according to the present invention, the active ingredient is removable by washing. If a fusible elastomer is applied, which is removable by washing, commonly the active ingredient as a whole, including the crosslinked fillers, is washed out. An example of a fusible elastomer which is removable by washing consists substantially of a copolymer of butyl acrylate and acrylic acid, preferably in the ratio of 80:20. However, it is also conceivable to apply a more durable active ingredient, which is not, or at least hardly, removable by washing. Examples of such durable active ingredients are aliphatic polyester polyurethane (Permutex® RU 13-011) and aliphatic polyester polyurethane (Permutex® RU-4049).

The composition according to the invention is preferably provided with additives, such as surfactants, perfumes, anti-bacterial additives, silicones for improving gliding between the fibers of the fabric, etc., as long as the additive does not interfere with the primary function of the polymer. The use of additives in a composition according to the invention can be very suitable when the compound is applied to a fabric by means of a domestic appliance, such as a washing machine or an iron.

The invention also relates to a wrinkle-reducing active ingredient as used in said composition and to a cartridge containing said composition and suitable for use in an iron.

The invention further relates to a method of improving wrinkle resistance in a fabric by use of said composition, comprising the steps of: A) applying the composition to the fabric, B) removing the wrinkles in the fabric, and C) permitting the liquid carrier to evaporate at least partly. The amount of active ingredient typically applied, particularly sprayed, onto the fabric is preferably from about 0.1 to about 10% by weight, more preferably from about 0.5 to about 5% by weight of the fabric. Once an effective amount of composition has been sprayed onto the fabric, the fabric is stretched or smoothed by hand according to step B). After the effective amount of composition has been applied to the fabric and preferably stretched, the liquid, in particular moisture, is permitted to evaporate at least substantially. The evaporation may occur in a passive way as well as in an active way by increasing the temperature of the fabric. Evaporation of the moisture is commonly relevant, as the particles of the fusible elastomer will stick together and thus form a solidified sheath around the fibers and yarns of the fabric. Furthermore, evaporation of moisture will commonly also result in stress relaxation in the yarns of the fabric. A decrease in the stored energy will maintain the fabric in its set, i.e. flat, state.

Preferably, the application of the composition to the fabric according to step A) is realized by means of a domestic appliance. Examples of such domestic appliances are a washing machine, an iron provided with a composition spraying reservoir, and other spraying devices for a composition according to the invention.

In a preferred embodiment of the invention, the removal of the wrinkles in the fabric according to step B) is realized by means of an iron at an increased temperature compared with an ambient temperature. In this way step C) will commonly be applied during application of step B). Thus, the increased temperature will lead both to an accelerated evaporation of applied liquid and to a softening of the fusible elastomer. Cooling down of the fabric results commonly in an elastic protective layer being formed around the stretched yarns of the fabric, such that the layers are bound to each other by elastic bridges. Deformation of the fabric after application the method according to the invention will temporarily lengthen said elastic bridges, which attempt to bring the yarns into, their original stretched, non-wrinkled state during a certain time.

The invention may be further illustrated with the following non-limitative examples and a single Figure showing an iron with a cartridge containing the claimed composition.

Example 1

A 12.5% (by weight) dispersion of a mixture of Permutex RU-4049® 40% aqueous emulsion and Estapor® 10% latex (175 - 225 nm core-shell particles consisting of a crosslinked elastomeric polystyrene-co-butadiene core and a carboxylated shell) in water was prepared by mixing the aforementioned emulsions with water in a ratio such that the amount of Estapor® was 10% with respect to the Permutex RU-4049®, (i.e. 1:9) hence 1.25% with respect to the total weight of the dispersion. This composition was then sprayed onto a piece of fabric (cotton type 407) such that the total pick-up with respect to the fabric weight was 40%. This led to an additive pick-up of 5% of the fabric weight, when the fabric was dry. The fabric was then ironed with an iron set to a temperature suitable for cotton, until the fabric was dry. After conditioning of the fabric for 24 hours, the WRA was measured for a piece of fabric 40 mm x 15 mm in both the warp and weft directions according to the standard AATCC method 66-1998. The average WRA value obtained from fabrics treated as above was compared with WRA measurements carried out on fabrics that were ironed without the application of any additives (reference value) as well as fabrics which were ironed after the application of 5% of fabric weight of Permutex RU-4049®only. The results are summarized

in the Table below, where Permutex RU-4049® is referred to as RU-4049 and the Estapor® latex is referred to as Estapor.

Treatment	WRA
Reference	140°
5% RU-4049	200°
5% (RU-4049 + Estapor 9:1)	210°

Example 2

A 12.5% (by weight) dispersion of a mixture of Permutex RU-4049® 40% aqueous emulsion and Dow Corning 1716® 30% aqueous microemulsion (crosslinked PDMS, polydimethylsiloxane) in water was prepared by mixing the aforementioned emulsions with water in a ratio such that the amount of Dow Corning 1716® was 20% with respect to the Permutex RU-4049® (i.e. 1:4), hence 2.5% of the total weight of the dispersion. This composition was then sprayed onto a piece of fabric (cotton type 407) such that the total pick-up with respect to the fabric weight was 40%. This led to an additive pick-up of 5% of the fabric weight, when the fabric was dry. The fabric was then ironed with an iron set to a temperature suitable for cotton until the fabric was dry. After conditioning of the fabric for 24 hours, the WRA was measured for a piece of fabric of 40 mm x 15 mm in both the warp and weft directions according to the standard AATCC method 66-1998. The average WRA value obtained from fabrics treated as above was compared with WRA measurements carried out on fabrics that were ironed without the application of any additives (reference value) as well as fabrics which were ironed after the application of 5% of fabric weight of Permutex RU-4049® only. The results are summarized in the Table below, where Permutex RU-4049® is referred to as RU-4049 and the Dow Corning 1716® is referred to as DC-1716.

Treatment	WRA
Reference	140°
5% RU-4049	200°
5% (RU-4049 + DC-1716 4:1)	225°

The Figure shows an example of an iron with an exchangeable reservoir for containing the claimed additive composition. The iron comprises a housing 1, a sole plate 2, a heating element 3 for heating the sole plate, an exchangeable reservoir for containing the additive composition 5, and a spraying nozzle means 6. The exchangeable reservoir 4 may be a kind of cassette or cartridge with a hard synthetic resin housing. The bottom 7 of the

exchangeable reservoir 4 is provided with an outlet 8 for the composition 5. A coupling piece 9 is connected at the lower side of the bottom 7, which coupling piece has a duct 10 of which an inlet is in communication with the outlet 8 of the reservoir 4 and of which an outlet terminates in an outlet tube 11. The coupling piece 9 may be integral with the cartridge in a first preferred embodiment. The iron comprises a delivery system 12 for delivering the composition 5 from the exchangeable reservoir 4 to the nozzle means 6 in order for it to be sprayed on the cloth to be ironed. The delivery system comprises a first channel 13, an outlet thereof being connected to an inlet of an electric pump 14 arranged inside the housing of the iron, and a second channel 15, an inlet thereof being connected to an outlet of the pump 14. An inlet of the channel 13 is provided with a coupling sleeve 16 for coupling to the outlet tube 11 of the coupling piece 9. An outlet of the second channel 15 is provided with a coupling sleeve 17. According to the invention, the exchangeable reservoir 4 is provided with the nozzle means 6. The nozzle means comprises a nozzle tube 18 terminating in a nozzle 19 having an aperture 20. An inlet of the nozzle tube forms a coupling tube 21 for coupling to the coupling sleeve 17 of the second channel 15. The exchangeable reservoir 4 can be inserted into a cavity 22 of the iron. A pivotable cover 23 can close the cavity 22. When a spray of composition is desired, the user starts the pump 14 by pressing a knob 24. The pump sucks the additive composition 5 from the reservoir 4 into the channel 13 and pumps it via the channel 15 and the nozzle tube 18 towards the nozzle 19. The exchangeable reservoir 4 including the nozzle means 6 can be implemented as a disposable cartridge, so that every new cartridge is provided with clean nozzle means.